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# THE RELATION OF PARASITES TO MOUNTAIN PINE BEETLE CONTROL IN WESTERN WHITE PINE

by
W. D. Bedard
Assistant Entomologist

Forest Insect Field Station,
Coeur d'Alene, Idaho,
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# THE RELATION OF PARASITES TO MOUNTAIN PINE BEETLE CONTROL IN WESTERN WHITE PINE

Respectfully submitted

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## Importance of Parasites

Forest entomologists have long realized the need for a closer utilization of the natural enemies of bark beetles, but only in recent years has it been possible to study these beneficial insects and their relation to control. Surveys following control work in infested areas have shown that a 100 percent eradication of the bark beetles in an infestation is an economic impossibility, and that control projects must therefore be more carefully planned in order to save the parasites and predators. Thus, these beneficial insects might concentrate upon the trees which were overlooked during control.

Mr. D. DeLeon[1] instituted a detailed study of the parasites and predators of the mountain pine beetle (Dendroctonus monticolae Hopk.)

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[1] DeLeon, Donald 1930-1931. The important parasites, predators, and associated insects of the mountain pine beetle in western white pine. Ms. Forest Insect Field Station, Coeur d'Alene, Idaho.

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in lodgepole pine and white pine during the seasons of 1928, 1929 and 1930. His reports show that this bark beetle is the host of a large number of insect enemies, the most important of which are the Braconid parasite, Coeloides dendroctoni Cush. and the predacious fly Medeterus aldrichi Wheeler. These insects are so valuable as controlling agents that sometimes from 80 to 98 percent of the mountain pine beetles within certain infested trees is destroyed by them.

Experiments performed during 1932 revealed that by using the peeling method of control, which is not effective against broods of new

adults, all the parasitic and predacious insects are destroyed. Furthermore, trees containing broods of new adults are in most cases heavily parasitized; thus the treatment of such trees often did more harm than good. The burning method of control, though effective in destroying the mountain pine beetle in all stages of development, destroys parasites as well. It was decided, therefore, that studies should be started whereby control methods could be revised to destroy the bark beetles but not harm their insect enemies. If this could be done, control would be doubly effective inasmuch as the brood in all trees left after control would be concentrated upon by the parasites and predators.

## Status and Results of the Investigation

In connection with control projects it had been noted that in certain white pine trees infested with the mountain pine beetle there were a large number of parasites, whereas in other trees there were very few. The first step in the investigation, therefore, was to determine which trees contained this concentration of parsites, and to establish criteria whereby these trees could be recognized by spotters so that they would not be treated during a control operation.

During the 1932 spring control operation on the Coeur d'Alene Forest, infested trees felled by the treating crews for treatment were examined, and notes were recorded concerning the percent of parasitism, date of attack, tree diameter, bark thickness, and location of the tree as to site, exposure, etc. An analysis of these data showed no correlation

between the above characters and the percent of parasitism except that the parasites were concentrated in the June-attacked trees.* The heavy

*The mountain pine beetle attacking western white pine has three attack periods, viz., an early attack in June, the main attack from July 15 to August 15, and a late attack from August 15 to the end of the season, the latter really appearing as a tapering off of the main attack.

parasitism by C. dendroctoni of the broods in these trees is explained by the fact that this insect requires mature or nearly mature larvae for oviposition, and emerges during July and August, at which time the June trees are the only ones containing larvae that are sufficiently mature to serve as its host. However, no sound characters for the recognition of these trees were established from the 1932 observations except that the parasites were most abundant in trees containing mature bark-beetle broods.

During the 1933 spring control project additional infested trees were examined with the objective of attempting to discover some definite characters whereby trees containing a high percentage of parasites could be recognized by spotters. Early in the investigation it became apparent that windfalls contained a large number of parasites. These windfalls are mostly June-attacked trees, because the most severe blowdowns occur during the winter and thus provide very favorable host material for these early emerging beetles. Table I gives a comparison of the parasitism occurring in windfalls and standing trees.

TABLE I

PARASITISM OCCURRING IN WINDFALLS AND STANDING TREES

| Tree type | Trees examined | Parasitism | Trees containing parasites | Parasitism in trees containing parasites |
|---|---|---|---|---|
| | Number | Percent | Percent | Percent |
| Windfalls | 49 | 41.2 | 75.5 | 54.5 |
| Standing trees | 78 | 24.6 | 44.8 | 54.8 |

It is apparent from a study of Table I that although a high percentage of the windfalls contain parasites, 25 percent contain no parasites at all. It is also apparent that 45 percent of the standing trees contain parasitism equal in amount to that occurring in the windfalls. Hence, in order to save the maximum number of parasites and leave the minimum amount of bark-beetle brood, the selection of trees to be left during control must be on a finer basis. It is a simple matter to determine the percent of parasitism in windfalls by examining the bark for Coeloides cocoons (Fig. 3), but standing trees present a more difficult problem.

Table II has been arranged to show the values of three characters for the identification of the standing "parasite trees". In this table the standing trees have been divided into two groups, i.e., those with parasitism greater than 25 per cent and those with parasitism less than 25 per cent. The characters for determination are: the presence or absence of parasite cocoons at the base of the tree (where the spotter usually makes his examination), the stage of development of the bark-beetle brood, and the presence or absence of woodpecker work on the trees.

TABLE II

PERCENT OF PARASITISM IN STANDING TREES INDICATED BY COCOONS, WOODPECKER WORK AND BROOD

| Parasitism | Trees examined | | Average parasitism | | Trees with cocoons at base | | Trees with woodpecker work | | Trees with mature brood [a] | |
|---|---|---|---|---|---|---|---|---|---|---|
| Percent | Number | | Percent | | Number | | Number | | Number | |
| More than 25 | 29 | | 65.3 | | 29 | | 26 | | 29 | |
| Less than 25 | 49 | | 0.8 | | 0 | | 8 | | 17 | |

[a] New adults, pupae or mature larvae.

It is quite obvious in Table II that all heavily parasitized trees show a few Coeloides cocoons at the bases. This is undoubtedly a good criterion of parasite trees, because even though there may be only one or two of these small white cocoons on one side of the tree, this is sufficient indication that the parasitism is much greater farther up the tree. Two secondary characters helpful in recognizing these trees are: the presence of mature brood beneath the bark, and the fact that the trees usually have been attacked by woodpeckers. The last two characters in themselves are not definite because some trees (about 32 per cent) will contain brood in the pupal or mature larval stage, but will contain no parasites. Similarly, approximately 18 percent of the "non-parasite" trees showed woodpecker work, which at best is an indefinite character because it is subject to yearly fluctuations, and is entirely dependent upon the maturity and heaviness of the bark-beetle brood.

## Conclusions and Recommendations

Early in the 1933 investigation, after an analysis of the data which had been secured up to that time, it was thought feasible to recommend that all windfalls showing 30 per cent or more parasitism should be left untreated. Spotters were instructed accordingly, and from about the middle of the Coeur d'Alene control project to its conclusion heavily parasitized windfalls were not treated on the Forks and Cabin Creek units.

Complete analysis of all data at the conclusion of the study shows that the presence of Coeloides cocoons near the base of the tree where examinations are usually made is a good character whereby spotters can distinguish standing "parasite trees", because their presence indicates a high percentage of parasitism higher up the tree. Therefore, all standing trees showing parasitism at the base should be left, together with the windfalls in which there is a high percentage of parasitism. The trees thus left would contain an average parasitism by Coeloides and Medeterus of 58.5 percent. In addition to these two most important beneficial insects, the "parasite trees" contain a much greater number of other parasites and predators such as Lonchaea viridana Meig., Phaonia n.sp., Cecidostiba dendroctoni Cush., Pachyceras coccoptogasteri Ratz., Rhoclerus sphegeus Fab., R. lecontei Nolc., and Thanasimus dubius Fab.

## Necessity for Additional Study

Considerable additional work is necessary even though the data given in this report add to our knowledge of parasites and predators by

showing which trees these insects prefer, how the parasite trees can be distinguished, and how the beneficial insects can be preserved from destruction during a control operation. Future investigation will be directed to determine whether the leaving of these trees actually assists in the reduction of the infestation. This may require a number of years before final results can be secured, but indications as to the increase or decrease of the parasites can be expected from year to year.

It has been noted above that the parasites and predators are concentrated in the early-attacked trees. A question therefore arises as to whether or not a portion of the parasites will synchronize their seasonal history with the development of the bark beetles in the trees attacked later in the season. It is quite probable that no difficulty will be encountered in developing a late-emerging strain of Medeterus, as this fly has a much longer oviposition period than Coeloides and does not require any definite larval stage, the eggs being laid on the outer bark, the larvae working in and securing food fortuitously. However, Coeloides have a comparatively short period of oviposition and require trees containing nearly mature larvae. These questions can only be answered by further experimentation.

Fig 2

Fig 3

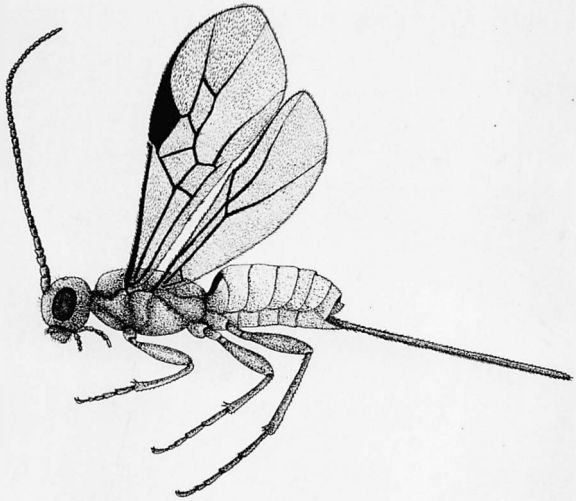

Fig. 1

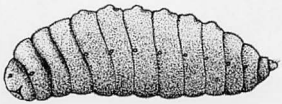

Fig. 4

Fig 5

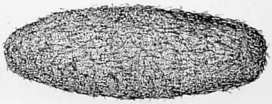

Fig. 6

Fig. 1 - Coeloides dendroctoni Cushman

1- Imago
2- Egg
3- First instar larva
4- Mature larva
5- Anterior view of head capsule of mature larva
6- Cocoon

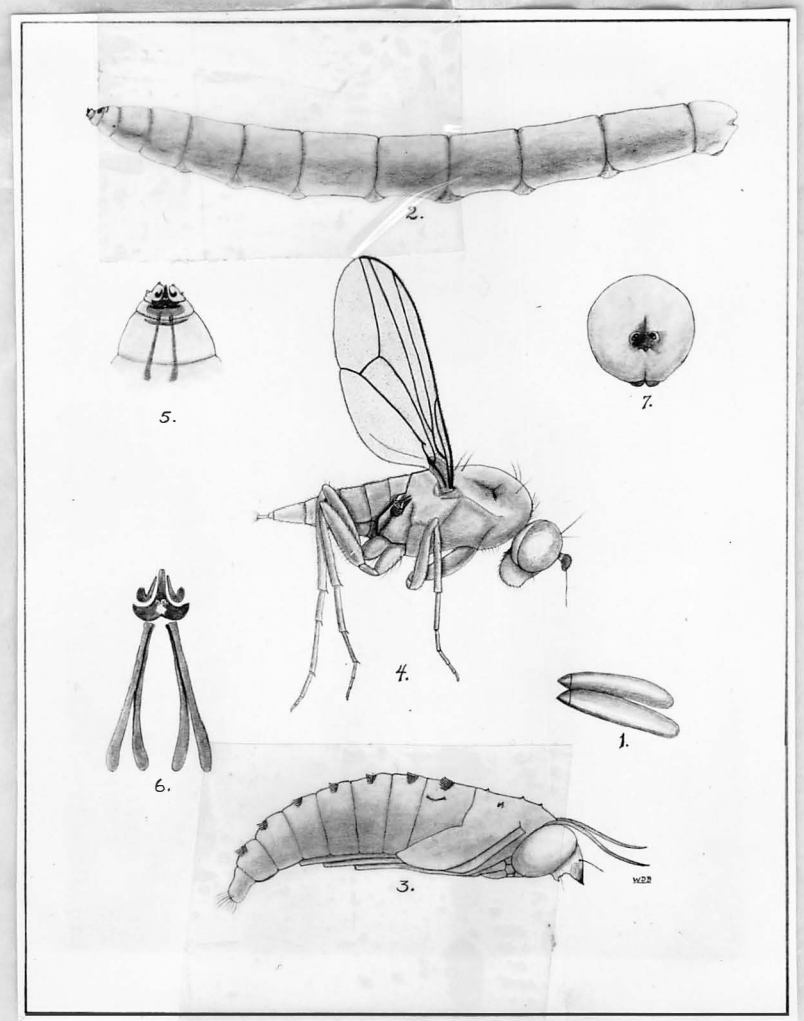


Fig. 2 - Medeterus aldrichi Wheeler

1- Eggs X20
2- Larva X12. Lateral view.
3- Pupa X12. Lateral view.
4- Imago X12. Lateral view.
5- Head of larva X20. Dorsal view showing arrangement of buccal appendages and position of sclerotized plates on head and prothorax.
6- Buccal appendages of larva X60. Dorsal view.
7- Apical segment of larva X20. Caudal view showing position of posterior pair of spiracles.

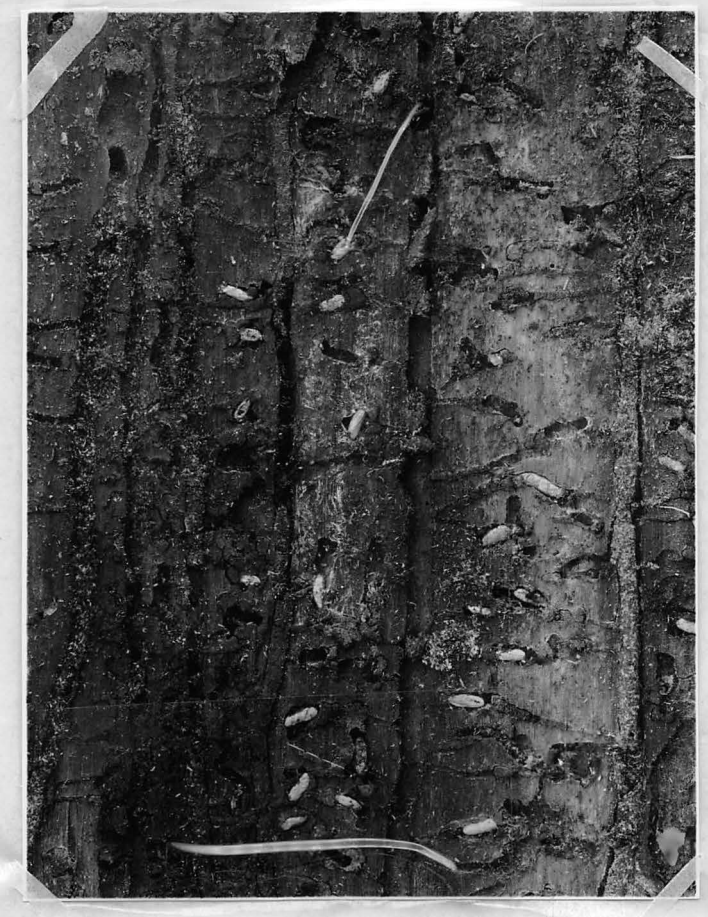

Fig. 3 - Western white pine bark showing the cocoons of Coeloides dendroctoni Cush. in the mines of mountain pine beetle larvae.